Title: HIGHWAY DESIGN MANUAL REVISION NO. 79 – CHAPTER 16 – MAINTENANCE AND PROTECTION OF TRAFFIC IN HIGHWAY WORK ZONES

Target Audience:
- Manufacturers (18)
- Local Govt. (31)
- Agencies (32)
- Surveyors (33)
- Consultants (34)
- Contractors (39)
- ____________( )

Approved:
/s/ Richard W. Lee
Richard W. Lee, P.E.
Deputy Chief Engineer, Design
6/5/14

ADMINISTRATIVE INFORMATION:
- This Engineering Bulletin (EB) is effective upon signature.
- Supersedes: EI 08-008, EI 10-041, EI 91-001

PURPOSE:

The purpose of this EB is to announce the availability of Revision 79 to the Highway Design Manual (HDM) - Chapter 16.

TECHNICAL INFORMATION:

HDM Section 16.5 is a new section which provides design guidance associated with Work Zone Impact Management Strategies. There are minor editorial changes to other sections associated with this issuance.

TRANSMITTED MATERIALS:

This revision has been incorporated into the on line version of HDM Chapter16 at:
https://www.dot.ny.gov/divisions/engineering/design/dqab/hdm/hdm-ch16

The pages modified by this revision can be found in the HDM Revisions Log at:
https://www.dot.ny.gov/divisions/engineering/design/dqab/hdm/hdm-revised-logs

BACKGROUND:

This issuance was developed to provide updated guidance associated with work zone impact management strategies and to further implementation of the Department’s Driver’s First Initiative.

CONTACT:

Direct questions regarding this issuance to Kevin Stanley of the Design Quality Assurance Bureau at 518-485-8612 or via e-mail at Kevin.stanley@dot.ny.gov.

Direct general questions regarding the Highway Design Manual to Norman Schips of the Office of Design at 518-485-8611 or via email at Norm.Schips@dot.ny.gov.
## MAINTENANCE AND PROTECTION OF TRAFFIC IN HIGHWAY WORK ZONES

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<tr>
<td>Section 16.6</td>
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16.1 INTRODUCTION

16.1.1 Organization of the Chapter

Section 16.1 Introduction describes the purpose of the chapter, states the general policy and objectives for maintenance and protection of traffic in construction work zones, and provides information on work zone traffic control training conducted by the NHI for Department Designers.

Section 16.2 Traffic Control Devices provides an overview of traffic control devices and includes guidance on their use for both daytime and nighttime operations.

Section 16.3 Safety Devices and Barriers discusses supplementary devices including temporary traffic barriers, vehicle arresting barriers, shadow vehicles, barrier vehicles, crash cushions and attenuating systems, sand barrel arrays, and temporary rumble strips.

Section 16.4 Work Zone Traffic Control Plans deals with the general requirements for traffic control plans, presents the fundamental principles of traffic control, describes the elements of work zones, discusses the considerations for work zone safety, details the requirements for work zone speed limits, and describes various work zone strategies. The section also describes the methods and strategies that may be used to aid workers, vehicle drivers, and pedestrians to navigate highway construction work zones.

Section 16.5 Work Zone Impact Management Strategies presented within the framework of the project development process and outlines a process for evaluating work zone traffic control strategies in the larger context of the rule on work zone safety and mobility, transportation management plans, significant projects, transportation management teams, detours, and nighttime construction are discussed.

Section 16.6 Vacant at this time.

Section 16.7 Dedicated Police Traffic Services will present guidelines and procedures for including dedicated police traffic services in a project.

Section 16.8 References is the list of all the references used to develop the chapter.

Titles of publications are shown in italics. The publications used in the preparation of this chapter are listed in Section 16.8.
alternative to raised markers.

16.4.7.6 One-Lane-Road Traffic Signals at Work Zones

Refer to Chapter 11 of this manual for design guidance for one-lane-road traffic signals.

16.4.7.7 Detours

General considerations for detours are discussed in subsection 16.5.6 of this chapter. When on-site traffic control methods are not appropriate, detours may be required.

A. Signing and Maintenance

Clear detour signing is critical to avoid confusing highway users. A survey of existing signs along the detour, the approaches to the detour, and within the closed section of the roadway (especially if it is open to local traffic) is necessary. The information gathered should be incorporated into the detour signing plan.

This is most important for destination and information signs and route marker assemblies. If, for instance, the distance to a destination is based on the closed route, the sign must be modified to reflect the distance along the detour. Existing route marker assemblies along the detour must also be modified with the addition of DETOUR (M4) route markers.

Traffic generators located within the closed section should also be considered. Informational and directional signing should be provided for travelers whose destinations are located within the closed section. Examples of such destinations might include colleges, state/local parks, stadiums, race tracks, etc.

The designer should investigate each of these issues and others specific to the particular project during the initial evaluation of off-site detours. Contact the Regional Traffic Engineering and Safety Group or local authorities for accident locations and numbers for on-system detours or off-system detours, respectively.

Detours require considerable traffic control, especially with high-speed freeway traffic. Drivers should be provided with enough information in advance of and throughout the detour to allow them time to make decisions and to help them determine how to return to the original roadway.

Reasonable advance notice should be provided to highway users when a highway or bridge is to be closed and traffic detoured. It is recommended that 1-2 weeks be allowed. The message can be passed on by traffic reports, television and radio spots, etc. Portable (and stationary, if available) variable message signs should be used in most cases.
The Highway Law requires that designated detour routes be signed. Refer to the MUTCD for examples of detour signing on designated detours.

Similarly, local businesses within a closed section of highway may be affected by loss of traffic when detour routes are employed. If possible, this problem should be minimized by taking care in scheduling and/or by providing temporary generic business signing, however, a roadside business has no legal claim to a given volume of passing traffic.

When considering a detour over a locally owned road, the detour construction cost will be limited to the basic work items normally considered under Section 619 of the Standard Specifications or pavement repairs that are needed for the detour to function for the life of the construction contract. This would include the installation, maintenance, and removal of items such as signs, pavement striping, etc. Special features such as pedestrian access and emergency services, if necessary, may also be included as legitimate project charges. Any substantial capital improvements requested by the municipality that are not absolutely necessary to make the detour work for the duration of the contract must be paid for by the municipality under a Betterment Agreement. However, if the municipality is not satisfied with the proposed detour improvements, they can deny use of their road(s) by the State.

An example of a form that may be used when establishing a detour is provided in Appendix 16A, Exhibit 16A1.

B. Establishing a Detour

When it is determined that a state highway must be closed and local road detours are needed to reroute traffic during project construction/reconstruction, the “owner” of the local road is contacted and the following procedure is followed.

For proposed detours which require improvements/repairs to handle increased traffic, refer to EI 82-39, Example 14-5, Detour Resolution, revised May 1982. The resolution or letter should clearly state that the Department will maintain the detour road during the period of use per Section 619, excluding snow and ice control.

An Official Order for temporary takeover of the local road by the State must then be issued. To fulfill the requirements of Section 42 of the Highway Law, the designer must prepare a draft official order for the closure of a highway as prescribed in the Manual of Administrative Procedures (MAP) 2.5-1-1, Official Orders, and include any necessary supporting documentation such as detailed descriptions of the property, maps, the section to be closed, and the temporary detour route. It must be cleared by all affected Regional Units and submitted to the Regional Director for concurrence, after which it is to be sent to the Office of Operations for final approval and issuance to the Town Clerk. The construction contract documents must specify the necessary improvements/repairs to be made to the detour during the period it is a temporary State highway, in
accordance with Standard Specifications Section 619. The official order can be conveniently filed concurrently with the “Notice of Restricted Highway” filing for the contract to the same recipients.

Where no detour improvements are needed to handle traffic, the construction contract documents must specify the erection and maintenance of necessary detour signs, to meet the requirements of Section 104 and Section 10, Subdivision 19 of the Highway Law. While no Official Order is required, the designer should obtain a detour resolution. Refer to EB 83-023 for an example “Detour Resolution.” It should state the Department’s intent to use the local road detour as written concurrence from the local jurisdiction, and make it clear to the local jurisdiction that the Department’s maintenance responsibility on the detour road will be limited to the detour signs only.

When detour routes are used, signing should be sufficient to direct motorists back to the route from which they were detoured, i.e., detours must maintain the continuity of the closed route. Detour directional signing and confirmatory signing should conform to National MUTCD Section 6F.59.

When State highways are utilized for project detours, maintenance of the detour will be performed by State forces, except that the contract documents must specify the Contractor is responsible for the necessary erection, maintenance, and removal of detour signs.

It is sometimes desirable and sometimes necessary to close single-lane ramps for paving or other work operations since it can generally be done in just a few hours. Designated (signed) detours should always be provided when the closed ramp serves to interchange traffic between numbered touring routes, i.e., when some of the traffic may be using the route numbering system to navigate.

Sufficient advance notice must be given since the designated detour exit may precede the closed exit. Variable message signs are ideal for these short-term closures.

16.4.7.8 Diversions

A diversion is a temporary rerouting of road users onto a temporary highway or alignment placed around the work area. Figure 6H-7 in the National MUTCD illustrates a work-site diversion for bridge and culvert replacements on a conventional highway.

HDM Chapter 2 should be used as guidance for diversion radii. Ideally, the speed used to determine the radii should be the same as the existing speeds at the site (usually the regulatory speed limit can be used). Where right of way constraints or excessive costs preclude the use of the existing speed, a lower speed may be acceptable. To determine an acceptable speed, consult the Traffic Engineering and Safety Group. For high-speed roadways, a 10-mph or 15-mph reduction may be acceptable. For low-speed roadways, a 5-mph or 10-mph reduction may
be acceptable. Because the superelevation of the curves at each end of the detour will be
dependent on the cross slope of the existing highway, those curves may need to be flatter than
the center curve where the desired superelevation can be designed.

The tangent lengths along the diversion will vary depending on site or right of way constraints.
Generally, a minimum length of 30 m should be provided. In extreme cases, it may not be
possible to achieve any tangent.

Lane widths along the diversion should be determined using the appropriate lane width table in
Chapter 2 of this manual.

Diversion shoulder widths should be at least 1.2 m to accommodate pedestrian and bicycle
traffic. Lesser widths may be acceptable if separate facilities for pedestrian and bicycle traffic
are provided. The Regional Landscape Group should be consulted.

If a temporary bridge is required (as opposed to a temporary culvert), a tangent section will be
required in the center curve where the temporary bridge is constructed. The length of the
tangent should generally be twice the length of the existing bridge or 30 m minimum. The
Regional Structures Group should be consulted.

Diversion geometry should be approved by the Regional Traffic Engineering and Safety Group
and the Regional Structures Group before right of way take lines are established.
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16.5 WORK ZONE IMPACT MANAGEMENT STRATEGIES

16.5.1 General

Every project should be assessed relative to its potential to impact the traveling public, the people who live adjacent to the work zones, and those along adjacent routes used by diverted or detoured traffic. Consideration should be given to the cumulative impacts that may occur because of other projects (by NYSDOT or others), either planned or underway, on adjacent routes and on a regional basis.

In order to thoroughly understand the potential impact of the construction operations and planned mitigation of those impacts, impact assessment should begin during project scoping and become progressively more rigorous as the design process continues through preliminary design toward the completion of construction contract documents. This is particularly important for large projects to reduce the risk of unanticipated and disruptive changes occurring late in design or during construction. The project assessment should consider management strategies aimed at reducing the magnitude and duration of work zone impacts.

Development of work zone impact management strategies is one element in the overall project development process described in the Project Development Manual (PDM). For example, it is within the context of the procedures described in the PDM that the project’s work zone traffic control (WZTC) plans are developed. Traffic control strategies are defined by the identified needs of, and problems faced by, the traveling public as they travel through or around the work zone and those of the contractor as it works to construct the project and maintain traffic flow. Projects can usually be built in a number of alternative ways. The objective of the designer is to identify the strategy that will optimize the competing goals of minimizing construction costs and inconvenience to the traveling public and adjacent property owners, while maximizing traffic and worker safety and operational efficiency. The Department’s policy on work zone traffic control adopts the premise that motorists using a facility that is being improved must accept a certain amount of inconvenience as part of the cost of the improvement. However, the objective of WZTC plans in all cases should be to balance the needs for high quality project construction at the least cost in the shortest amount of time with the least inconvenience to the public while providing adequate safety for both the workers and the public.

Designers are expected to work closely with their colleagues in the Regional Traffic Safety and Mobility Group and Regional Construction Group throughout the development of work zone impact management strategies. The Regional Traffic Safety and Mobility Group is responsible for overseeing the Regional Surface Transportation Control (STC) activities. The objective of the STC function is to ensure the coordination of traffic control for all roadwork, incident, and maintenance activity on the state highway system within each Region, and to serve as a hub for the information flow necessary for facilitating that traffic control, during both the planning and execution stages. Within this context, it is critical that Designers are aware of the concept of STC and how it is managed within the Region. Transportation Management Plans (TMPs) should be consistent with the objectives of the STC.
16.5.2 Transportation Management Plans and Significant Projects

Title 23, Section 630, Subpart J of the Code of Federal Regulations (Rule on Work Zone Safety and Mobility), requires a TMP for all Federal-aid highway projects, including local projects that are Federally funded. One hundred percent state-funded projects should also follow the Rule.

A TMP is a program of activities for alleviating or minimizing work-related traffic delays by the effective application of traditional traffic handling practices and an innovative combination of various strategies. These strategies encompass public awareness campaigns, motorist information, demand management, incident management, system management, construction methods and staging, and alternate route planning. TMPs may consist of three components: 1) The Temporary Traffic Control (TTC) component; 2) The Transportation Operations (TO) component; and 3) The Public Information (PI) component. TMPs deal with project-related impacts within a project corridor and sometimes beyond.

The type of TMP needed for a project is based on whether the project is determined to be a "significant" project. A "significant" project is generally a project that a State or Local transportation agency expects will cause a relatively high level of disruption, as detailed below. This designation and judgment of “significance” is made by the DOT Region where the project resides.

16.5.2.1 “Significant” Projects

A. The Rule states that interstate system projects within the boundaries of a designated Transportation Management Area (TMA) that occupy a location for more than three days with either intermittent or continuous lane closures shall be designated as “significant” projects. A judgment of “significance”, therefore, is not needed for projects meeting these criteria, as they are always “significant”. A TMA is an area designated by the US Secretary of Transportation, having an urbanized area population of over 200,000. The following TMAs have been designated in New York State:

New York--Newark, NY--NJ--CT.
Buffalo, NY
Rochester, NY
Albany, NY
Syracuse, NY
Poughkeepsie--Newburgh, NY

The maps in Appendix 16B have been developed to assist the designer by highlighting the limits of interstate highways within the approximate geographic boundaries of TMAs. The exact geographical boundaries of TMAs change periodically so these maps are conservative in the identification of these limits by establishing the limit at the nearest interchange outside of the current TMA boundary.

B. For projects that do require a decision of “significance” by the Regions (i.e. not meeting the criteria in A. above), note that projects that should be designated as "significant"
under the Rule are usually large projects, on major highways or critical urban facilities with large traffic volumes, design-build projects, projects which coincide with large special events, projects delivered to letting with accelerated design schedules, projects that have received multiple inquiries by elected officials or significant media attention regarding the inconvenience to motorists, and projects with long detours or with long delays expected. Projects may also be deemed “significant” because of their cumulative impact in combination with other projects.

When a project is deemed by the Region to be “significant”, this decision of “significance” is recorded in the Work Zone Safety and Mobility Section of the IPP/FDR, PSR/FDR, or combined DDR documents as part of the project development process; see the PDM Shells. In these cases, TTC plans alone are not able to achieve substantial balance among the TMP objectives (see factors to consider in subsection 16.5.5.7), so there is a need for PI and TO strategies and activities. In Exhibit 16-19, TTC and TO work zone impact management strategy components are broken down into subcategories, and examples of the activities in each subcategory are provided. Fillable check boxes have been incorporated into Exhibit 16-19. If desired, by checking the appropriate boxes, this Exhibit may be used to document the TTC and TO strategies used on a “significant” project. Note that there is no expectation that all of the sample strategies provided in Exhibit 16-19 will be used on any single “significant” project. Since the TMP encompasses both the design and construction phases of the project(s) it covers, some of the strategies within the TMP will be initiated and implemented during construction. For PI strategies used on a significant project, Appendix 2 of the PDM is the Public Involvement Manual. The Public Involvement Manual Appendix C is a Public Involvement Plan Checklist. This will serve to document PI.

16.5.2.2 Projects not designated as “Significant”

If the project is not deemed to be “significant” (in accordance with the criteria and guidance in subsection 16.5.2.1), the TMP must contain, at a minimum, the TTC plan component.

16.5.3 Definitions and Terminology

The categories and subcategories of work zone impact management strategies referred to in Exhibit 16-19 defines the terminology used in this Section of HDM Chapter 16. Note that Temporary Traffic Control (TTC) plans are also referred to in the federal regulations and guidance as Work Zone Traffic Control (WZTC) plans.

A comprehensive TMP Strategy Matrix, developed by the FHWA, is available at: TMP Strategy Matrix. This matrix provides considerations that assist in identifying the specific strategies may be employed for the wide variety of projects and project conditions that may be encountered.
Exhibit 16-19  Work Zone Impact Management Strategies

<table>
<thead>
<tr>
<th>Temporary Traffic Control (TTC)</th>
<th>Traffic Control Devices</th>
<th>Project Coordination, Contracting and Innovative Construction Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction phasing/staging</td>
<td>□ Temporary signs</td>
<td>□ Project coordination</td>
</tr>
<tr>
<td>Full roadway closures</td>
<td>- Warning</td>
<td>- Coordination with other projects</td>
</tr>
<tr>
<td>Lane shifts of closures</td>
<td>- Regulatory</td>
<td>- Utilities coordination</td>
</tr>
<tr>
<td>- Reduced lane widths</td>
<td>- Guide/Information</td>
<td>- Right-of-way coordination</td>
</tr>
<tr>
<td>to maintain number of lanes</td>
<td>□ Variable Message Signs</td>
<td>- Coordination with other transportation infrastructure</td>
</tr>
<tr>
<td>(constriction)</td>
<td>(VMS)</td>
<td></td>
</tr>
<tr>
<td>- Lane closures to provide</td>
<td>□ Arrow panels</td>
<td></td>
</tr>
<tr>
<td>worker safety</td>
<td>□ Channelizing devices</td>
<td></td>
</tr>
<tr>
<td>- Lane shift to shoulder/median</td>
<td>□ Temporary pavement</td>
<td></td>
</tr>
<tr>
<td>to maintain number of lanes</td>
<td>markings</td>
<td></td>
</tr>
<tr>
<td>One-lane, two-way operation</td>
<td>□ Flagger and uniformed</td>
<td></td>
</tr>
<tr>
<td>Two-way traffic on one side of</td>
<td>control officers</td>
<td></td>
</tr>
<tr>
<td>divided side of divided</td>
<td>□ Temporary traffic</td>
<td></td>
</tr>
<tr>
<td>facility (crossover)</td>
<td>signals</td>
<td></td>
</tr>
<tr>
<td>Reversible lanes</td>
<td>□ Lighting devices</td>
<td></td>
</tr>
<tr>
<td>Ramp closures/relocation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeway-to-freeway interchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>closures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Night work</td>
<td></td>
<td></td>
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<tr>
<td>Weekend work</td>
<td></td>
<td></td>
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<tr>
<td>Work hour restrictions</td>
<td></td>
<td></td>
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<tr>
<td>for peak travel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian/bicycle access</td>
<td></td>
<td></td>
</tr>
<tr>
<td>improvements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business access improvements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-site detours/use of alternate routes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Flexible barriers</td>
<td></td>
</tr>
</tbody>
</table>
## Demand Management Strategies
- Transit service improvements
- Transit incentives
- Shuttles services
- Ridesharing/carpooling incentives
- Park-and-ride promotion
- High-occupancy vehicle (HOV) lanes
- Toll/congestion pricing
- Ramp metering
- Parking supply management
- Variable work hours
- Telecommuting

## Corridor/Network Management Strategies
- Signal timing/coordination improvements
- Temporary traffic signals
- Street/intersection improvements
- Bus turnouts
- Turn restrictions
- Parking restrictions
- Truck/heavy vehicle restrictions
- Separate truck lanes
- Reversible lanes
- Dynamic lane closure system
- Ramp metering
- Temporary suspension of ramp metering
- Ramp closures
- Railroad crossings controls
- Coordination with adjacent construction site(s)

## Work Zone Safety Management Strategies
- Speed limit reduction /variable speed limits
- Temporary traffic signals
- Temporary traffic barrier
- movable traffic barrier systems
- Crash-cushions
- Temporary rumble strips
- Intrusion alarms
- Warning lights
- Automated Flagger Assistance Devices (AFADs)
- Construction safety supervisors and inspectors
- Road safety audits
- TMP monitor/inspection team
- Team meetings
- Project on-site safety training
- Safety awards/incentives
- Windshield surveys

## Traffic/Incident Management and Enforcement Strategies
- ITS for traffic monitoring/management
- Transportation Management Center
- Traffic screens
- Call boxes
- Mile-post markers
- Tow/freeway service patrol
- Photogrammetry
- Coordination with media
- Local detour routes
- Contract support for incident management
- Incident/emergency response plan
- Dedicated (paid) police enforcement
- Cooperative police enforcement
- Increased penalties for work zone violations

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§16.5.3  6/5/14
16.5.4 Establishing a Transportation Management Team

When a project has been identified as a “significant” project, a Transportation Management Team should be formed with designated Department representatives of all involved functional areas and a leader of the Team. The Transportation Management Team should be closely coordinated with the Project Team formed as part of the Project Scoping Procedure described in Chapter 3 of the PDM. The Team should be an interdisciplinary Team composed of stakeholders that can provide valuable input on what strategies to include in the TMP to help manage the work zone impacts of a project through design and construction. Team stakeholders should represent different perspectives and will vary depending on the nature of the project. Team members may include staff from Planning, Design, the Traffic Safety and Mobility Group, Construction, Maintenance, External Relations, Integrated Modal Services, and Structures; and external stakeholders such as the FHWA, local government, public transportation providers, enforcement agencies, emergency services, and schools. If the project is being designed by consultants, they should also be represented. The Regional Transportation Management Center and Surface Transportation Control function should always be represented on the Team.

In developing and managing the TMP, the Transportation Management Team is responsible for keeping an overview of project TTC, TO, and PI-related issues such as:

- Scheduling of other highway projects and utility projects in the corridor.
- Emergency response and incident management during construction.
- Transit, ride sharing, park-and-ride lots, etc.
- Traffic impact management strategies on alternate routes, including coordination with local governments for impacts on local streets.
- Involvement of affected businesses and the public.
- Public information needs and media involvement.
- Detours.
- Nighttime construction and other construction time restrictions.
- Time-related contract provisions such as incentives, disincentives, liquidated damages, and lane rentals.
- The needs of both commuter and through traffic.
- Truck traffic including permitted oversize and overweight vehicle traffic.
- The cost effectiveness of potential work zone impact management strategies.
- Regional approval and public support of the TMP.
- Prediction of the effects of mitigation measures on road users choice of travel routes and mode of transportation.
- Cumulative affect of constraints on feasibility of construction.

16.5.5 Evaluation of Work Zone Impact Management Strategies

For projects that are not classified as significant projects, the TMP may consist only of a TTC plan. However, agencies are encouraged to consider TO and PI for these projects as well. Analysis of the impact of a project will ultimately determine which work zone management strategies are to be used. Exhibit 16-20 provides an overview of the evaluation process.
Exhibit 16-20  Process for Evaluation of Work Zone Impact Management Strategies

The steps in the process shown in Exhibit 16-20 are detailed below:

1. ASSEMBLE DATA
   Describe the work to be done and provide the required data.

2. DETERMINE EXTENT OF ROADWAY OCCUPANCY
   Assess the first level of roadway capacity.

3. IDENTIFY FEASIBLE ALTERNATIVES
   Determine which strategies may be appropriate for the type of work activity to be performed.

4. ANALYZE VOLUME/CAPACITY RELATIONSHIPS
   This involves a more detailed analysis of capacity constraints, queue lengths, and delays.

5. ANALYZE CAPACITY IMPROVEMENT TECHNIQUES
   If problems exist or have been identified in the earlier steps, additional techniques should be considered to reduce delays and congestion.

6. DEFINE ALTERNATIVES
   Review the alternatives for practicality and achievability.

7. QUANTIFY IMPACTS
   Relative impacts of different strategies need to be measured not only from a traffic flow perspective, but also with regard to constructability and construction cost, as well as environmental and economic impact.

8. MODIFY PROCEDURES
   Modify the project design, phasing, and/or schedule as required in response to problems.

9. SELECT PREFERRED ALTERNATIVE
   For the selected strategy, develop the necessary traffic control plans for implementation.
The steps in the process shown in Exhibit 16-20 are detailed below:

1. **Assemble Data** - To analyze the impact, data must be gathered about the highway including existing road conditions, operational features, horizontal and vertical restrictions, and peak and off-peak speed and traffic volume data. Project information must be gathered including the type of work to be done, project and work limits, tentative schedule, and potential detour routes. Community information must be gathered including jurisdictions involved, business access, emergency facilities locations, schools, other user groups (bicyclists, pedestrians, etc.), activities or events, and designated access routes. The extent and type of data to be assembled depends on the complexity and size of the project.

2. **Determine the Extent of Roadway Occupancy** - During construction, most projects require occupancy of some portion of the traveled way or shoulder by the construction activity. The extent to which the roadway is occupied by construction activities and buffer space and is unavailable for use by traffic is known as roadway occupancy. Roadway occupancy results in a reduction in capacity of the roadway, and defines a number of constraints within which the traffic control strategy must be developed. Both spatial requirements and time durations of the roadway occupancy must be determined.

3. **Identify Feasible Alternatives** - Identify Strategies in accordance with Exhibit 16-19 and the FHWA's Work Zone Impact Management Strategies. The guide for the types of work zones and feasible work zones are in Exhibits 16-21 and 16-22.
Exhibit 16-21  Descriptions of the Basic Types of Work Zones

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Constriction</td>
<td>Lane widths are reduced to retain the number of lanes normally available to traffic. Applicable only if the work area is mostly outside the normal traffic lanes. May depend on the availability of shoulders. Least disruptive of all work zone types.</td>
</tr>
<tr>
<td>Lane Closure</td>
<td>Close off one or more normal traffic lanes. May require capacity analysis to determine whether serious congestion will result. Use of shoulder or median as a temporary lane may mitigate the capacity problems.</td>
</tr>
<tr>
<td>Alternating One Way Flow</td>
<td>Uses one lane for both directions of traffic. Traffic must be controlled and coordinated with the use of flaggers or traffic signals.</td>
</tr>
<tr>
<td>Temporary Bypass (Diversion)</td>
<td>Requires the total closure of the roadway in one or both directions. Traffic is diverted to a temporary roadway constructed within the highway right of way. Requires extensive preparation of the temporary roadway to withstand the traffic loads.</td>
</tr>
<tr>
<td>Intermittent Closure</td>
<td>All traffic in both directions must be stopped for a short period of time to allow the work to proceed, after which, traffic is allowed to proceed. Normally applicable only on very low-volume roadways.</td>
</tr>
<tr>
<td>Crossover, including Two-lane Two-way Operation</td>
<td>The traffic in one direction is rerouted across the median to the opposite traffic lanes. May also require the use of the shoulder and/or lane constrictions to maintain the same number of lanes. Consideration must be given to separation devices, crossover design, and length before selecting this strategy. Long work zones can be a delay concern for drivers. Refer to Section 16.4.7.4 for further guidance.</td>
</tr>
<tr>
<td>Use of Shoulder or Median</td>
<td>The shoulder or median serves as a temporary lane. Must determine if there are underpasses or other vertical clearance issues. Must determine if shoulder or median will adequately support the expected traffic loads. Must determine if the traffic can be transitioned safely to the temporary lane. May be used in combination with other work zone types or as a separate technique. Potential drainage and rollover concerns.</td>
</tr>
<tr>
<td>Detour</td>
<td>Requires total road closure and rerouting of traffic to existing off-site facilities. Particularly desirable when there is unused capacity on roads running parallel to the closed roadway. May require improvements to existing roadway(s) to make it suitable to carry detoured traffic.</td>
</tr>
</tbody>
</table>
Exhibit 16-22 Guidelines for Identifying Feasible Work Zone Types

Source: Planning and Scheduling Work Zone Traffic Control

This step in the process is a detailed investigation of the volume/capacity relationships of the different strategies identified from the previous step, and the consequent general levels of congestion that may develop. The Regional Traffic Safety and Mobility Group will generally be the program area responsible for this analysis.

The Highway Capacity Manual is a fundamental and extensive resource for examining capacity for a wide variety of conditions and facilities. NCHRP Report 475 provides the principles for analyzing capacity of work zones and comparing alternative work zone impact management strategies, including the estimation of user costs and evaluation of the costs of accidents related to work zone activity. The following excerpt from that report explains why it is important that determinations about project impacts on capacity be made by those familiar with not only the project but also the region and communities that are impacted:

There is no widely accepted definition of “unacceptable” congestion. It is often not the same among urban and rural areas, and even among different areas within the same state. “Unacceptable” congestion must therefore be determined by local norms. Typically, the determination of whether congestion is unacceptable on a given project involves consideration of changes in level of service during construction, queue length/duration and resulting delay, and disruption of access to businesses and to travel patterns throughout the community. Another critical consideration is whether a queue grows so large that it blocks other intersections or interchanges. This is called ‘spillback’ and often has large negative delay and safety consequences that the profession cannot calculate at this time. The agency responsible for the work must determine what level of congestion and delay is unacceptable for each project on the basis of the impact of the project on the community.

Lane closure time restrictions will be supplied by the Regional Traffic Safety and Mobility Group to the Regional Design Engineer (RDE). The “Department Approved List of Traffic Analysis Software” is available under “Resource Links” on the HDM Chapter 5 Web Page.

A. **Work Zone Capacity**

The roadway capacities of the various work zone strategies should be determined to compare them to the traffic volumes that will use the facility. Due to constrained space for traffic on the project and a shortfall of available capacity on alternative routes, the project traffic demands may be less than the normal traffic demands, but may still exceed those for which the work zone is designed. When project traffic demand exceeds capacity, a queue will develop and an estimate of queue length can be calculated. Depending upon the length and duration of the queue, certain strategies may have to be abandoned, unless measures can be taken to increase capacity or reduce demand. Examples of such measures include restricting construction work to certain hours of the day or night, or certain days of the week, removing
parking along the streets or roads involved, and diverting traffic to other facilities with available capacity.

B. Queue Delay, Size, and Duration

When demand volume exceeds capacity, congestion will occur and a queue will form. The duration of the congestion, the amount of delay, and the size of (number of vehicles in) the queue may be calculated using the procedure and equations given in Chapter 2 of the FHWA's Publication Work Zone Road User Costs - Concepts and Applications. Due to the many project type and location variables, engineering judgment should be exercised to determine the need for an analysis and the depth of the analysis when one is needed.

5. Analyze Capacity Improvement Techniques - If, after the initial analysis, unacceptable capacity deficiencies are still anticipated on all feasible alternatives, additional work zone impact management strategies (see Exhibit 16-19) should be considered to mitigate delays and congestion.


When the capacity improvement techniques analysis is completed, some of the strategies may be unacceptable.

Components that must be included in defining the Work Zone Impact Management Strategies are below:

- Basic construction sequence, e.g., on multilane highways, reconstruction by halves, parallel/adjacent reconstruction, serial/segmental reconstruction (two-lane, two-way operations), complete closure, or a combination of sequences.
- Overall construction time period or construction seasons and how they will affect user costs.
- Traffic management strategy through the construction area with segment-by-segment delineation for each phase of construction and definition of the time period for each segment and phase.
- Traffic diversions including identifying all routes to be used and necessary associated improvements for diversions and detours.
- Proposed temporary detours.
- Specific traffic control plans showing the traffic control devices for each strategy.

7. Compare Impacts - Relative impacts of different work zone impact management strategies need to be considered from a traffic flow, safety, constructability, construction cost, environmental, and economic perspective.

Factors to consider are:
• Traffic delay and safety
  • Vehicle volume.
  • Delay/Travel time.
  • Travel speed.
  • User cost.
  • Accidents.
  • Vehicle occupancy.
  • Pedestrian use and accessibility.
  • Bicycle use and accessibility.

• Constructability
  • Affect on quality of construction.

• Project costs
  • Traffic control and enforcement.
  • Maintenance of traffic control devices.
  • Construction and demolition.
  • Efficiency of the work area.

• Environmental impacts
  • Air pollution.
  • Energy consumption.
  • Noise levels.
  • Light pollution
  • Community Services

• Business loss.

• User Costs.

  A. User costs associated with construction work zones are:
     • User time cost.
     • Vehicle crash cost.
     • Vehicle operating cost.
     • Vehicle emission cost.

Work zone road user costs can be determined using the guidance available at: Work Zone Road User Costs - Concepts and Applications and Valuation of Time in Economic Analysis. Also, a support document entitled “New York Value of Time and Vehicle Cost” is available under “Resource Links” on the HDM Ch16 Web Page.

If a project returns more to the public than is spent, the project is considered a cost-effective project. For temporary traffic maintenance estimates, when the average delay per vehicle is
15 minutes or less, the user costs as determined by that method, should be reduced as shown in Exhibit 16-23.

Exhibit 16-23 Allowable Delay and User Cost Reductions

<table>
<thead>
<tr>
<th>Average Delay/Vehicle (minutes)</th>
<th>% of User Cost Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 5</td>
<td>0</td>
</tr>
<tr>
<td>5 to 10</td>
<td>50</td>
</tr>
<tr>
<td>10 to 15</td>
<td>75</td>
</tr>
<tr>
<td>greater than 15</td>
<td>100</td>
</tr>
</tbody>
</table>

A spreadsheet for cost comparison of on-site staging versus a detour option is available. See “Work Sheet For Comparing Off-Site Detour with On-Site Staging” is available under “Resource Links” on the HDM Ch16 Web Page.

B. Project Cost Impacts

All costs of construction, mitigation, and traffic control, including an allowance for enforcement, should be used in the analysis. If, for example, there are mitigation costs involved in the detour scheme ultimately selected, include those costs in the overall project cost.

Alternative Work Zone Impact Management Strategies may have substantial project cost impacts. For example, a given strategy may involve time restrictions on construction activities, i.e., construction during off-peak hours only, the effective work day may be reduced by 25% or more. This will increase the overall duration of the project and may substantially affect the project cost.

Other strategies may have an impact on the amount of available work area during certain construction phases, such as work space limitations resulting from an adjacent project, causing increased project costs.

It is essential that the constructability of the Work Zone Impact Management Strategies be reviewed to ensure that unrealistic constraints are not placed on the project. This is accomplished by maintaining close contact with, and receiving input from the Regional Construction Group during the design phase.

16.5.6 Detours
A. General Considerations for Detours

A detour is a temporary rerouting of road users onto an existing highway in order to avoid a WZTC zone. Depending on the impact to traffic caused by project work being performed, detours may be considered if a detour might be the most cost-effective solution. In the case of total roadway closure where traffic is detoured to adjacent roadways, the detour route(s) must have the capacity to handle both existing and detoured traffic.

When evaluating a longer detour on a State highway against a shorter detour on a local road the designer should keep in mind that the posted detour is for travelers following the route who are not familiar with the area. Most local and frequent users of the route will likely select an alternate route that best serves their needs, regardless of the posted detour.

Detours for rural work zones have special considerations and are covered in Section 16.5.6.B.

For a large project, a detour is often the best solution for only certain phases of the work. During project scoping, the Resident Engineer and Regional Traffic Safety and Mobility Group should send potential detour routes to the designer for analysis. Collaboration with the Regional Traffic Safety and Mobility Group should continue throughout design. Traffic Engineers can advise on the route's ability to handle truck traffic, increased traffic volume, and the need for signals and signs and other improvements to establish an acceptable level of safety throughout the life of the detour. The Regional Materials Group should be consulted regarding any pavement condition issues on the detour route. Considerations for detours are provided below and in Bridge Manual Section 3.7:

Construction operations which sometimes require detours are:

- Bridge replacements.
- A significant raising of the existing highway profiles while utilizing the same, or nearly the same horizontal alignment.
- Construction of grade separations at highway crossings.
- Reconstruction work on bridge approach slabs.
- Combination of fill widening and profile.
- Culvert replacements for culvert spans of 8 ft. or greater.
- Miscellaneous work that requires trenching across the highway for long periods of time.
- Other work requiring profile changes at frequent intervals along the segment of roadway being improved.
- Bridge rehabilitation where there is not enough width to adequately maintain traffic under staged construction.

Considerations for detour routes are:

- State highway or local road.
- Cross section shape (normal or rounded crown).
- Lane and shoulder widths.
Mainline and intersection horizontal and vertical geometry and sight distances.
- Pavement/shoulder structure and condition; need for repairs.
- Minimum design criteria.
- Duration of the detour (short-term or long-term).
- Length of the detour vs. length of road to be closed from the beginning to the end of the detour.
- Determine if existing traffic control (traffic signals, pavement markings and signing) needs upgrading to conform to NYSDOT standards.
- Existing level of traffic control (signing, signals, pavement markings, etc.).
- Speed limit on the detour route.
- Travel time on the detour route.
- Peak-hour traffic volumes (local + detoured); heavy-truck volumes.
- Level of service.
- Accident rates and potential problem areas.
- Capacity restrictions/analysis.
- Ability to handle trucks (geometric restrictions) and over-dimensional permitted vehicles. Weight and height restrictions.
- Commuter transfer facilities (e.g., bus stops, park-and-ride lots).
- Local traffic generators (events, employment centers, etc.).
- Adjacent or nearby projects.
- Structural condition of bridges and pavement on the detour route.
- Pedestrian and bicyclist access and accommodation.
- Roadside hazards and safety issues (steep slopes, drop-offs, fixed objects, clear zone, condition and location of guide rail).
- Roads prone to flooding.
- Evacuation Routes.
- Emergency services access.
- Railroad crossings.
- Neighborhood characteristics.
- Economic impacts on businesses.
- Effects on schools and school bus routes.
- Use by farm machinery.
- Environmental effect of any necessary construction.

Advantages of road closures and detours are:
- Conflicts between traffic and the work activity are eliminated.
- Driver avoids congestion in the work zone.
- Safer for the workers.
- Shortens the construction schedule and can improve quality.
- May provide permanent improvements to the detour route.

Disadvantages of road closures and detours are:
- Longer driving time.
- Higher user costs.
• Lower level of service on the detour route.
• Higher traffic volumes and accident rates on the detour route.
• Driver confusion.
• Disruption to local business traffic and emergency vehicles.
• Costly upgrading may be necessary to prepare the detour for increased traffic.
• Sometimes not feasible on high volume roads.

Once the cost data and impacts for each strategy have been determined and documented, the Regional Director (or his/her designated representative) should select the most cost-effective detour consistent with public safety. As used herein, cost-effective means a decision based upon careful consideration of the construction cost, user cost, (including time, operation, and accident costs) and demolition cost with consideration for quality of construction, duration of construction, and other intangible impacts. The Regional Director may choose to allow their designated representative to decide on the detour option for “routine” projects. However, if a preferred strategy is not readily apparent, or when the cost of the detour recommended exceeds the lowest cost option, the Regional Director will decide the appropriate detour scheme. All decisions should be documented in the project records and any involvement by local jurisdictions should be acknowledged by them in writing.

B. Considerations for Detours for Rural Work Zones

For rural non-freeway highway reconstruction work, and rural bridge and culvert replacement work, it is the Department’s policy that offsite detours should be the preferred alternative when selecting a method of temporary traffic control due to its lower cost, increased speed of construction, potential for better quality construction, and potential for a safer work environment for workers and motorists. This policy applies whenever the normal travel paths must be shut down or significantly restricted for a substantial period of time (longer than can be handled under short or intermittent daily occurrences).

While the detour route may still be preferred, other traffic control schemes may be considered when:
• An improved alignment will allow an on-site diversion (e.g., the preferred alternative improves a nonstandard horizontal bridge approach curve to reduce crash frequency and severity).
• The detour will be in place for more than one construction season;
• The detour route has vertical clearance or weight restrictions below that of the current route. A separate detour for oversize and overweight permit vehicles is not feasible (e.g., increases trip for through traffic by more than 25 miles);
• The detour route would result in traffic queuing-up across at-grade mainline railroad crossings;
• The detour route would result in a decrease in level of service to E or worse during construction;
• The detour route substantially increases traffic through low-speed (posted 35 mph or less) residential neighborhoods or elementary school zones;
• There are a substantial number of bicyclists or pedestrians who would be severely impacted;

OR,

The combined cost of the following outweigh the detour alternative by more than 25% (note that when evaluating user costs, no more than 25% of the user cost should be compared directly with the Department’s capital costs):

• The cost to upgrade the detour route to a minimum of 10 ft lanes and 2 ft shoulders (14 ft minimum for one-way traffic), accommodate a large school bus design vehicle, and address safety items from a road safety audit (using 1R requirements from HDM Chapter 7), and

• The cost of staging emergency response vehicles on the opposing side of the closed bridge or culvert where response times (using the most direct route) will be worse than the response time that currently exists to the furthest part of the district.

When an offsite detour route will not be used for a rural work zone, the design approval document should include documentation of the above factors.

If the decision is made to implement a detour, reference HDM 16.4.7.7.B, “Establishing a Detour”.

16.5.7 **Nighttime Construction**

A. General

Nighttime construction (operations) is defined in the Standard Specifications as work occurring after sunset and before sunrise. Activities that require lane closures on high-volume roadways are often considered for night work. The same types of work zones used for daytime construction may be considered for nighttime construction (see Exhibit 16-24).

Whenever it is not possible to achieve substantial balance among the Department’s objectives through work zone impact management strategies for daytime construction, the feasibility of nighttime construction shall be evaluated. Consideration of night construction activities requires an understanding of the tradeoffs that are involved. Exhibit 16-24 lists the factors affecting the nighttime construction decision and summarizes the advantages and disadvantages of nighttime construction.
**Exhibit 16-24**

### Night Time Operations: Considerations

#### Traffic-Related

<table>
<thead>
<tr>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Congestion</strong></td>
<td>Significantly reduces or avoids traffic congestion and motorist delays.</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>Lower traffic demand at night lead to reduced overall crashes. Some workers may be more aware of the dangers and more conscious of safety practices.</td>
</tr>
<tr>
<td><strong>Traffic Control</strong></td>
<td>Increased flexibility in work zone due to less traffic interference and improved level of service.</td>
</tr>
</tbody>
</table>

#### Construction-Related

<table>
<thead>
<tr>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality</strong></td>
<td>Quality can be enhanced when sufficient level of lighting is provided. Cooler temperatures can enhance the quality of the concrete set at night.</td>
</tr>
<tr>
<td><strong>Productivity</strong></td>
<td>Less traffic interference and longer work shifts can enhance productivity and efficiency. Allows more lanes to be temporarily closed to accommodate work activities.</td>
</tr>
<tr>
<td><strong>Equipment Repair</strong></td>
<td>Breakdown of equipment can be mitigated through the use of contingency plans.</td>
</tr>
<tr>
<td><strong>Work Operations</strong></td>
<td>Possibility of decreased completion time through double shift work.</td>
</tr>
</tbody>
</table>
### Social

<table>
<thead>
<tr>
<th></th>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Condition</td>
<td>Driver anger and frustration as a result of traffic delays may be reduced.</td>
<td>Concerns over driver fatigue, drowsiness, confusion and effects of alcohol increase at night.</td>
</tr>
<tr>
<td>Worker Health</td>
<td>Health of workers can be affected positively by less exposure to automotive emissions caused by decreased congestion.</td>
<td>Concerns over biological clock factors, and various physiological and mental stresses that can result from lack of sleep. Workers often perceive that their level of safety decreases at night and that speeds are higher. Employee morale may be negatively affected. Normal social and family life of workers may be disrupted.</td>
</tr>
</tbody>
</table>

### Economic

<table>
<thead>
<tr>
<th></th>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Cost</td>
<td>Losses incurred by surrounding business as a result of operations may go down as a result of eliminating work during day time.</td>
<td>Trucking and shipping industries which rely extensively on night time operations may be impacted.</td>
</tr>
<tr>
<td>Driver Cost</td>
<td>Driver costs will decrease because of lower vehicle operating cost and time savings.</td>
<td>Costs of delivering materials may be slightly higher for night time than day time. Night operations may be more expensive because of overtime, night premium pay, lighting expense and enhanced traffic control costs.</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>Reduced traffic interference and enhanced flexibility can drive down the cost of nighttime operations compared to daytime operations.</td>
<td></td>
</tr>
</tbody>
</table>

### Environmental

<table>
<thead>
<tr>
<th></th>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Pollution</td>
<td>Excessive lighting can be controlled by using new technologies.</td>
<td>Light pollution can be caused by excessive lighting of the work zone.</td>
</tr>
<tr>
<td>Noise</td>
<td>Disturbances can be mitigated by using the latest technologies, and proper planning and administration of work zone.</td>
<td>Can cause noise, vibration, light and other disturbances to neighboring communities.</td>
</tr>
<tr>
<td>Fuel Consumption/Energy Use</td>
<td>Less fuel is burned through idling cars in congested work zones. New lighting technologies consume less energy.</td>
<td>Energy consumed to provide lighting.</td>
</tr>
<tr>
<td>Air quality</td>
<td>Pollution from automotive exhaust emissions decreases from reduced congestion levels.</td>
<td></td>
</tr>
</tbody>
</table>

### B. Nighttime Construction Plans

Whenever traffic is maintained through the work zone it is preferable to provide as much positive protection (buffer space, barrier, or delineation) as practical between construction
activities and the traffic. Lane closures using channelizing devices provide the least protection, but some projects will be forced to utilize this option because reasonable detour routes are not available and all travel lanes must be available to carry traffic during daylight hours. Where the work area will remain at a fixed location for more than a few days, consideration should be given to using movable concrete barriers. However, for typical night construction operations such as paving and pavement/joint repairs, the work area is generally not fixed and it becomes necessary to rely on channelizing devices and barrier vehicles to form temporary lane closures on a nightly basis.

C. Lighting Requirements

Illumination requirements related to work zone traffic control are contained in Section 619 of the Standard Specifications.
16.8 REFERENCES


Research Board, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418.


- Policy on Moveable Concrete Barrier, June 25, 2001, by NYSDOT Region 11, Long Island City, NY 11101.


• **Roadside Design Manual**, Appendix A. Virginia Department of Transportation, Location and Design Division, 1221 East Broad Street, Richmond, VA 23219.

• **Roadway Design Manual**, New Jersey Department of Transportation, 1035 Parkway Avenue, PO Box 600, Trenton, NJ 08625.

• Speed Limits in 65 mph Work Zones - Signing Requirements memo from T.C. Werner, August 31, 1995. NYSDOT Traffic Engineering and Highway Safety Division, Albany, NY 12232.

• Standard Drawing TM525, Oregon Department of Transportation, Traffic Management Section, 355 Capitol Street NE, Salem, OR 97301-3871.


• **Transportation Management for Major Highway Reconstruction**, Special Report 212,

APPENDIX 16A

Local Road Detour Information Form
MAINTENANCE AND PROTECTION OF TRAFFIC
IN HIGHWAY WORK ZONES

APPENDIX 16B
Transportation Management Areas
The detour route substantially increases traffic through low-speed (posted 35 mph or less) residential neighborhoods or elementary school zones;

• There are a substantial number of bicyclists or pedestrians who would be severely impacted;

OR,

The combined cost of the following outweigh the detour alternative by more than 25% (note that when evaluating user costs, no more than 25% of the user cost should be compared directly with the Department’s capital costs):

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Exhibit 16B-1

New York-Newark, NY-NJ-CT.
Exhibit 16B-3
Rochester, NY
Exhibit 16B-4

Albany, NY
Exhibit 16B-5

Syracuse, NY
Exhibit 16B-6

Poughkeepsie-Newburg, NY